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PROGRAM AND ABSTRACTS OF THE TWELFTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF PARASITOLOGISTS

ATLANTIC CITY, NEW JERSEY

DECEMBER 29, 30 and 31, 1936

PROGRAM[1]

TUESDAY MORNING SESSION, DECEMBER 29, 10:00 A. M.; COMMITTEE ROOM 2, MUNICIPAL AUDITORIUM.

Read

1. Parasites of Equines in the Panama Canal Zone. (10 min.) (Lantern.) (Also by demonstration.) A. O. Foster, Gorgas Memorial Laboratory, Panama.

2. *Elaeophora poelli* Railliet and Henry, 1912, in African Buffalo and its Taxonomic Affinities. (10 min.) (Also by demonstration.) J. H. Sandground, Harvard University.

3. Morphological and Biological Studies on *Tetrameres crami* Swales, 1933, an Important Nematode Parasite of Ducks. (8 min.) (Lantern.) W. E. Swales, McGill University. (Introduced by T. W. M. Cameron.)

4. The Value of Esophageal Structures in Nemic Classification. (15 min.) (Lantern.) B. G. Chitwood, U. S. Bureau of Animal Industry.

5. Some Egg and Larval Characters of Nematode Parasites of Cattle. (10 min.) (Lantern.) Roy L. Mayhew, Louisiana State University.

6. The Fecundity of Single *Strongyloides ratti* Parasites. (15 min.) (Lantern.) George L. Graham, Rockefeller Institute for Medical Research, Princeton, N. J.

7. Effects of Various Physical Factors on the Survival of Eggs and Infective Larvae of the Swine Nodular Worm, *Oesophagostomum dentatum.* (5 min.) L. A. Spindler, U. S. Bureau of Animal Industry.

8. The Effect of Tropical Sunlight on Eggs of *Ascaris suis.* (5 min.) L. A. Spindler, U. S. Bureau of Animal Industry.

9. Observations on the Diagnosis and Epidemiology of Trichinosis in a Maryland Family. (15 min.) G. F. Otto, Johns Hopkins University.

10. Acanthocephala from Amphibians and Reptiles of China. (5 min.) (Charts.) H. J. Van Cleave, University of Illinois.

TUESDAY AFTERNOON SESSION, DECEMBER 29, 2:00 P. M., COMMITTEE ROOM 2, MUNICIPAL AUDITORIUM.

Read

11. Hookworm Infestation and Hookworm Disease in Egypt. (15 min.) (Lantern.) J. Allen Scott, Rockefeller Foundation and Department of Public Health of the Egyptian Government.

[1] An alphabetical author index will be found at the end of the program.

12. Studies on Intestinal Parasite Infections of Students of Berea College, Kentucky. (15 min.) (Lantern.) William H. Headlee and Raymond M. Cable, Purdue University.

13. Diagnosis and Treatment of Intestinal Parasitism by the Intra-Intestinal Thermal Method. (15 min.) (Lantern, Motion Picture Projection.) Damaso de Rivas, Philadelphia, Pa.

14. Further Studies in Ascarid Nutrition. (12 min.) (Lantern.) J. E. Ackert and A. E. Freeman, Jr., Kansas State College.

15. Observations Upon the Glycogen Relationships in *Ascaris*. (15 min.) (Lantern.) Theodor von Brand, Johns Hopkins University.

16. Retention of Guanidine Bases, a Toxic Factor in Trichinosis. (15 min.) Paul D. Harwood, Jessie T. Cutler, Lloyd A. Spindler, and S. X. Cross, U. S. Bureau of Animal Industry.

17. A Relationship in Equines Between Age of Host and Number of Strongylid Parasites. (15 min.) (Lantern.) A. O. Foster, Gorgas Memorial Laboratory, Panama.

18. Studies on Trichinosis. I. The Incidence of Trichinosis as Indicated by Post-Mortem Examination of 300 Diaphragms. (15 min.) Maurice C. Hall and B. J. Collins, U. S. Public Health Service.

19. Studies on Trichinosis. II. Some Correlations and Implications in Connection with the Incidence of Trichinae Found in 300 Diaphragms. (15 min.) Maurice C. Hall and B. J. Collins, U. S. Public Health Service.

20. Studies on Active Acquired Resistance, Natural and Artificial, in the Rat to Infection with *Strongyloides ratti*. (15 min.) (Lantern.) A. J. Sheldon, Johns Hopkins University.

By Title

21. A Laboratory and Clinical Analysis of *Strongyloides stercoralis* Infection. E. Harold Hinman, Louisiana State University.

WEDNESDAY MORNING SESSION, DECEMBER 30, 10:00 A. M., BALL ROOM, MUNICIPAL AUDITORIUM.

By Demonstration

1. Parasites of Equines in the Panama Canal Zone. (Also read.) A. O. Foster, Gorgas Memorial Laboratory, Panama.

2. *Elaeophora poelli* Railliet and Henry, 1912, in African Buffalo and its Taxonomic Affinities. (Also read.) J. H. Sandground, Harvard University.

22. A Cerebral Coenurus from *Cercopithecus nictitans*. J. H. Sandground, Harvard University.

23. The Distribution of *Schistosoma haematobium* and *Schistosoma mansoni* in Egypt. J. Allen Scott, Rockefeller Foundation and Department of Public Health of the Egyptian Government.

24. The Life History and Comparative Pathology of *Fascioloides magna*. T. W. M. Cameron and W. E. Swales, McGill University.

25. Some New Cercariae from *Planorbis pfeifferi, Melanoides tuberculata* and *Pseudoglessula boivini*. Annie Porter and H. B. Fantham, McGill University.

26. The Pathology of Two Trematode Infections of *Lymnaea natalensis*. H. B. Fantham and Annie Porter, McGill University.

27. Notes on the Development of *Gorgodera amplicava* in the Final Host. Theron O. Odlaug, New York University.

28. Studies on North American Polystomes. Allard A. Paul, New York University.

29. Morphology and Life History Studies of *Microcotyle spinicirrus*, a Monogenetic Trematode from the Gills of *Aplinodonotus grunniens*. Leslie W. Remley, State University of Iowa. (Introduced by L. O. Nolf.)

30. A Sporozoan Parasite of Larval Trematodes. W. E. Martin, Purdue University.

31. The Occurrence of *Euryhelmis squamula* (Rudolphi, 1819) in the United States. Allen McIntosh, U. S. Bureau of Animal Industry.

32. The Specific Validity of the Human and Pig *Ascaris*, Based on a Comparative Study of Spermatogenesis and Oogenesis. Lawrence S. Ritchie, Northwestern University and The Woman's College of the University of North Carolina.

33. Experimental Infestations of Rats and Mice with *Capillaria hepatica*. George W. Luttermoser, Johns Hopkins University.

34. The Life Cycle of *Ophidascaris labiatopapillosa* Walton, 1927. A. C. Walton, Knox College.

35. A Suggested Life Cycle for *Multicaecum tenuicolle* (Rud., 1819) Walton, 1927. A. C. Walton, Knox College.

36. Effect of Irradiated Ergosterol on Trichinized White Rats. Wayne W. Wantland, Northwestern University.

37. Effect of Irradiated Ergosterol and Irradiated Milk on Calcification of Trichina Cysts in Cats. Wayne W. Wantland. Clayton Hansen and Robert E. Feeney, Northwestern University.

WEDNESDAY MORNING, DECEMBER 30, 11:30 A. M., COMMITTEE ROOM 2, MUNICIPAL AUDITORIUM.

Presidential Address

38. Parasite Reactions to Host Modifications. Robert Hegner, Johns Hopkins University.

WEDNESDAY NOON, DECEMBER 30.

12:30 PARASITOLOGISTS' LUNCHEON, for members and guests.

1:30 ANNUAL BUSINESS MEETING.

WEDNESDAY AFTERNOON SESSION, DECEMBER 30, 3:00 P. M., COMMITTEE ROOM 2, MUNICIPAL AUDITORIUM.

39. Variations in *Dientamoeba fragilis* and a Suggestion as to its Pathogenicity. (15 min.) (Lantern.) D. H. Wenrich, University of Pennsylvania.

40. Exposure of Three Endoglobular Bovine Parasites to Different Degrees of Temperature. (10 min.) (Chart.) Chas. W. Rees, U. S. Department of Agriculture.

41. A 24-Hour Asexual Cycle in a New Strain of *Plasmodium praecox* (*relictum*). (10 min.) (Lantern.) Fruma Wolfson, Johns Hopkins University.

42. The Cultivation of *Trichomonas foetus* Free from Bacteria. (15 min.) (Lantern.) Justin Andrews, Johns Hopkins University.

43. *Trichomonas columbae* as a Cause of Death in the Hawk. (10 min.) (Lantern.) Robert M. Stabler and Herman A. Shelanski, University of Pennsylvania.

44. Hyperparasitism: A Species of *Hexamita* (Protozoa, Flagellata) Found in the Reproductive Systems of *Deropristis inflata* (Trematoda) from Marine Eels. (10 min.) A. V. Hunninen and Ralph Wichterman, Oklahoma City University and Temple University.

45. Division and Conjugation in *Nyctotherus cordiformis* (Ehr.) Stein (Protozoa, Ciliata) with Special Reference to the Nuclear Phenomena. (15 min.) (Lantern, Chart.) Ralph Wichterman, Temple University.

By Title

46. Experimental Amoebiasis in Rats with Cysts of Human Carriers. H. Tsuchiya, Washington University.

47. Ciliates Infesting Acapulco Sea Urchins. Philip B. A. Powers, University of Pennsylvania.

48. A Race of *Trichomonas augusta* in the Liver Abscesses in a Frog. Robert M. Stabler and Miriam I. Pennypacker, University of Pennsylvania.

THURSDAY MORNING SESSION, DECEMBER 31, 10:00 A. M.; COMMITTEE ROOM 2, MUNICIPAL AUDITORIUM.

Read

49. The Sucking Lice of American Monkeys. (10 min.) (Lantern.) Henry E. Ewing, U. S. Department of Agriculture.

50. The Louse Fly, *Lynchia fusca,* Parasite of the Owl, *Bubo virginianus pacificus,* a New Vector of Malaria of the California Valley Quail. (15 min.) W. B. Herms and C. G. Kadner, University of California.

51. The American Dog Tick or Eastern Rocky Mountain Spotted Fever Tick. (15 min.) (Lantern.) F. C. Bishopp and Carroll N. Smith, U. S. Department of Agriculture.

52. Equine Encephalomyelitis in Western Montana in 1936. A Discussion of the Implications of Arthropod Transmission. (15 min.) (Motion Picture Projection.) Cornelius B. Philip and Herald R. Cox, U. S. Public Health Service.

53. Penetration of the Common Sunfish by the Holostome Cercaria, *C. multicellulata.* (10 min.) (Lantern.) George W. Hunter, 3d, Wesleyan University.

54. On the Life History of *Apophallus venustus* with Observtions on the Life History of *Parametorchis* in Canada. (7 min.) (Motion Picture Projection.) Thomas W. M. Cameron, McGill University.

55. The Life Cycle of *Cercariaeum lintoni* Miller and Northrup. (10 min.) (Lantern.) Horace W. Stunkard, New York University.

56. The Life History of *Diphyllobothrium mansonoides.* (15 min.) (Lantern.) Justus F. Mueller, New York State College of Forestry.

57. The House Fly and Fowl Tapeworm Transmission. (12 min.) (Lantern.) J. E. Ackert and W. M. Reid, Kansas State College.

By Title

58. Progress of Spirochaete Infection in the Developmental Stages of the Host Tick, *Ornithodoros hermsi* Wheeler. Charles M. Wheeler, University of California.

59. Parasites of *Amphiuma tridactylum.* Harry J. Bennett and Joseph D. Re, Louisiana State University.

60. Experimental Studies on the Trematode, *Parorchis acanthus* Nicoll. Raymond M. Cable, Purdue University.

61. Experimental Studies on *Neascus vancleavei.* M. S. Ferguson, University of Illinois. (Introduced by H. J. Van Cleave.)

62. A Note on the Geographical Distribution of the Genus *Haplosplanchnus* (Trematoda). H. W. Manter, University of Nebraska.

63. Some Peculiarities in the Occurrence of Gyrodactyloid Trematodes on North American Fishes. Justus F. Mueller. New York State College of Forestry.

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ABSTRACTS

1. *Parasites of Equines in the Panama Canal Zone.* A. O. Foster, Gorgas Memorial Laboratory, Panama.

From 97 horses and mules owned by the Panama Canal Department of the U. S. Army, there have been recovered 44 different helminth species. These included 34 Strongylid species from the large bowel and 10 somewhat unrelated species from various parts of the alimentary tract and body cavity. Throughout the studies particular attention was given to the quantitative occurrence of the several species, their localizations in the host, and the lesions associated with them. The occurrence of each of the species in each of the individual animals has been recorded. The animals to which reference is made in this abstract include a first series of 48 animals, studied in 1935, upon which a detailed report has already appeared (Jour. Parasit., Oct., 1936) and a second series which became available in 1936. Of the total, quantitative studies were conducted upon 86 animals, and the occurrence of extra-Strongylid species was studied in all. Because of the many interpretations which were derived from the data of the first series, it was considered desirable to utilize the opportunities presented by the second series for checking upon earlier interpretations.

2. Elaeophora poelli *Railliet and Henry, 1912, in African Buffalo and its Taxonomic Affinities.* J. H. Sandground, Harvard University.

Elaeophora poelli, the type and until recently the only described species in the genus, hitherto known only from the aorta of the Malaysian *Buffelus bubalus* and *Bos indicus,* is here reported from Buffalo (*Syncerus caffer*) in the Belgian Congo where it was found in association with *Onchocerca armillata.* The morphology of the parasite is redescribed. We find that the only basis for the taxonomic separation of the genera *Elaeophora* and *Onchocerca* is the structure of the oesophagus and (presumably) the uterine divisions. If separate genera are to be retained, Wehr and Dikmans' (1935) recently described species *E. schneideri* and *O. cervipedis* will require generic reallocation.

3. *Morphological and Biological Studies on* Tetrameres crami *Swales, 1933, an Important Nematode Parasite of Ducks.* W. E. Swales, Institute of Parasitology, McGill University.

The male is described for the first time and the female is redescribed. A list of twelve anatine hosts is given. The life history has been studied in detail, the intermediate host being an amphipod; two species, *Gammarus fasciatus* Say and *Hyalella knickerbockeri* (Bate), have been used as experimental intermediate hosts. It is suggested that *G. fasciatus* is probably the intermediary involved in the infestations of most wild ducks, while *H. knickerbockeri* would be responsible for infestations in domestic ducks. Fish could be used to reduce the numbers of amphipods in waters used as feeding grounds by ducks.

4. *The Value of Esophageal Structures in Nemic Classification.* B. G. Chitwood, U. S. Bureau of Animal Industry.

The number and arrangement of esophageal nuclei, the number and position of orifices of esophageal glands, the form of the esophageal lumen and the form of the esophago-intestinal valve have been found valuable in tracing nemic phylogeny. New evidence of the affinities of nemic groups are shown as a result of recent studies. Syncytium formation in the esophageal glands, multiplication of esophageal nuclei and partial loss of nuclear and cell constancy in the esophagus and other organs are shown to be a general tendency in parasitic nematodes; this tendency is correlated with gigantism.

5. *Some Egg and Larval Characters of Nematode Parasites of Cattle.* Roy L. Mayhew, Louisiana State University.

6. *The Fecundity of Single* Strongyloides ratti *Parasites.* GEORGE L. GRAHAM, Rockefeller Institute for Medical Research, Princeton, N. J.

Fertile *Strongyloides ratti,* established in the laboratory rat by means of a single direct development larva, afforded an opportunity to observe the fecundity of this nematode. The number of progeny (infective larvae and adults of the free-living generation) counted from isolations of cultures made from 24 hour fecal collections constitute the basis for this study. The patent range of 93 rats studied was from 5 to over 300 days. About 3,500 cultures were classified into five yield categories, *viz.,* 0 (during patency), 1–10, 11–20, 21–40 and over 40 offspring per culture. These data were grouped by weeks of parasitic age, thus facilitating graphic analysis of the apparently normal course of reproduction. This revealed low initial yields during Week I, which increased in Week II to a maximum. In subsequent weeks there was a slow decrease of high yields, with increasing frequency of yields in the two lowest categories. After Week XIII, no cultures were observed which fell into the highest yield category. Roughly, the first five weeks are those in which the offspring per diem is greatest, after which it declines to a low level where it may persist for months. If the routine techniques of collecting, culturing and isolating fail to account for every offspring, it would nevertheless appear that losses, if any, are small. In any event, the progeny counts have high validity on a comparative basis. Occasionally parasites lived in these rats for over six months with no indication from the culture counts that other than the originally introduced parasite was involved.

7. *Effects of Various Physical Factors on the Survival of Eggs and Infective Larvae of the Swine Nodular Worm,* Oesophagostomum dentatum. L. A. SPINDLER, U. S. Bureau of Animal Industry.

Eggs in feces subjected to a temperature of 41° to 44° C. for 47 hours failed to hatch; life in the eggs was destroyed instantly at a temperature of 60° C. Ten per cent of the infective larvae survived continuous freezing at −5° to −10° C. for 259 hours. Eggs in feces survived continuous freezing at −1° to −9° C. for periods of 72 to 75 hours. Infective larvae on glass survived air drying at 20° to 30° C. for 25 days, while eggs in feces spread in thin layers on glass did not survive air drying at 20° to 30° C. for 24 hours. Infective larvae on experimental plots outdoors under a heavy growth of grass lived 14 months, while those on bare experimental plots survived for approximately 9 months. When eggs were buried to varying depths beneath sandy clay soil outdoors they hatched and the larvae migrated to the surface and remained viable for approximately 9 months. When the surface soil became dry larvae were found in the moist subsoil; when the surface soil became moist many larvae migrated upward to the surface; when the top soil became dry again larvae were found only in the moist subsoil.

8. *The Effect of Tropical Sunlight on Eggs of* Ascaris suis. L. A. SPINDLER, U. S. Bureau of Animal Industry.

Tests to determine the effect of tropical sunlight on eggs of the swine ascarid removed from uteri of gravid females were carried out in Puerto Rico, during the summer of 1936. In certain tests eggs were placed in water in Syracuse watch glasses and in other tests eggs were allowed to dry in thin layers in Syracuse watch glasses; the watch glasses were then placed in crystallizing dishes containing a small amount of water and exposed to the sun. The temperature of the water in the crystallizing dishes was maintained between 30° and 35° C. Exposure to the sun of nonsegmented eggs in water for approximately 3 hours destroyed their vitality. Exposure to the sun of embryonated eggs for 5½ to 9 hours destroyed life in the embryos. Dried eggs in late stages of segmentation, but not yet embryonated, did not survive 4½ hours' exposure. The vitality of dried embryonated eggs was destroyed in approximately 5 hours; dry, undeveloped eggs were killed by approximately 2 hours' exposure. The exposure to sunlight of undeveloped or developing eggs either in water or in a dried condition for a time insufficient to destroy their vitality pro-

duced marked retardation in the rate of embryonation as compared to that of unexposed control eggs.

9. *Observations on the Diagnosis and Epidemiology of Trichinosis in a Maryland Family.* G. F. Otto, Johns Hopkins University.

Of twelve persons known to have eaten infected pork two were critically ill, three others bedridden, three mildly ill, and four were hardly ill at all. Preliminary diagnoses were: typhoid fever, 1; acute alcoholism, 1; influenza complicated by chronic bronchitis and mild encephalitis, 1; influenza and mumps, 1; influenza, 1; mumps, 2; rheumatism, 1. Skin tests were positive in ten cases, including the eight who were ill. Two of the persons without symptoms gave only ± reactions. Ten had a marked eosinophilia. All infections came from one home-killed hog which had been raised where garbage was intermittently fed.

10. *Acanthocephala from Amphibians and Reptiles of China.* H. J. Van Cleave, University of Illinois.

Acanthocephala collected by Faust in his studies in China include two undescribed species of the genus *Acanthocephalus* from amphibians. Each species shows definite geographical limitations. Representatives of the same genus from snakes seem to have become established in the intestine of the snakes when infested amphibians were used as food. Encysted post-larval Acanthocephala were found in both amphibians and reptiles. Their role in the life cycle will be discussed.

11. *Hookworm Infestation and Hookworm Disease in Egypt.* J. Allen Scott, Rockefeller Foundation and Department of Public Health of the Egyptian Government.

Egypt has long been considered a classic center of hookworm disease. Data from an extensive series of examinations show that whereas the infestation is widespread, in many districts involving as high as 90 per cent of the population, nevertheless the individual worm burden is extremely low. Three considerations grow out of these facts. First, it seems unusual for such a small number of worms per individual to produce the severe effects long attributed to hookworm disease in Egypt. Part of the discrepancy is probably due to confused diagnosis, but it is true that anemia and other manifestations are associated with the infestation. It is suggested that these effects are the result of hookworm infestation being superimposed on that of other parasites. Experiments to test this possibility are outlined. Second, the implications of this situation on control of the disease are that in the event of satisfactory control of other parasitic diseases, especially schistosomiasis, hookworm disease might disappear. Third, an epidemiological explanation is needed for this occurrence of infestation in a high percentage of the population, but with the average individual infested by only a small number of hookworms. Data regarding the climate, habits of the people and soil chemistry offer the basis for a satisfactory explanation.

12. *Studies of Intestinal Parasite Infections of Students of Berea College, Kentucky.* William Hugh Headlee and Raymond M. Cable, Purdue University.

Stools were examined from 514 students of the Junior High School and Academy of Berea College, Kentucky. Of these students 410 were boys and 104 were girls. The ages ranged from 12 to 30 years, 70 per cent of the individuals being in the age-group 16–20 years inclusive. The parasites found and the percentage incidence were as folows: *Endamoeba histolytica,* 7.2; *Endolimax nana,* 47.3; *Iodamoeba bütschlii,* 9.5; *Giardia lamblia,* 6.6; *Chilomastix mesnili,* 1.4; *Ascaris lumbricoides,* 8.0; *Trichocephalus trichiurus,* 9.1; *Necator americanus,* 20.4; *Strongyloides stercoralis,* 2.7; *Enterobius vermicularis,* 0.4, and *Hymenolepis nana,* 3.7. The incidence of infection with protozoa of one or more species was 67.3 per cent; that of helminths of one or more species, 31.9 per cent, while 24.1

per cent of the individuals examined harbored infections of one or more species of both protozoa and helminths. These students came from fifteen states of the United States, and a few were from other countries. Forty-eight Kentucky counties, primarily of the eastern mountainous region, were represented. An analysis of the data by counties (where numbers permit), points out that certain ones had a high incidence of infection while others had a contrastingly low incidence. In general the incidence of *Necator* was higher than that of either *Ascaris* or *Trichocephalus,* and that of *Trichocephalus* higher than that of *Ascaris,* although in a few counties represented the incidence of *Ascaris* was higher than that of either *Trichocephalus* or *Necator.*

13. *Diagnosis and Treatment of Intestinal Parasitism by the Intra-Intestinal Thermal Method.* Damaso de Rivas, Philadelphia, Pa.

The method consists in the flushing of the duodenum with hot salt solution or the colon with 1–5000 copper sulphate solution at the duodenal or rectal temperature at 45° to 47° centigrade, for the treatment of protozoa and metazoa parasitic infestments of the small or large intestine, respectively. The method is based upon the fact that this temperature will kill the parasites in five to ten minutes without causing any pathological disturbance to the intestine and practically is free from any inconvenience to the patient.

14. *Further Studies in Ascarid Nutrition.* J. E. Ackert and A. E. Freeman, Jr., Kansas State College.

Additional tests have been made in an effort to determine whether the fowl nematode *Ascaridia lineata* acquires its nutriment from the food of the fowl or from the intestinal epithelium, as has been claimed for other ascarids. The tests were made by parasitizing a considerable number of chickens of the same age with the same number of worm eggs. After allowing one week for the worms to become established, the parasitized chickens were divided into two groups, one fed only by muscular injections of glucose solution (injected) and the other group (control) continued on the regular ration. The injected chickens lived for variable lengths of time. When an injected chick died, its control brood mate was killed and the worms from each bird isolated, counted and measured. The results of the tests on 96 chickens showed a marked difference in the growth of the worms under these contrasted conditions. The worms from the glucose injected chickens were able to grow but little, whereas the *A. lineata* from the regularly fed chicks grew normally. For example, during a period of experimentation covering from five to 20 days, the worms from the injected birds ranged from 3 to 5.6 mm. in length, while those from the normally fed chickens ranged from 5.3 mm. at the end of five days of the experiment to 40.1 mm. at the close of 20 days of experimentation. In fact, in the absence of the chicken food in the fowl intestine, the worms made almost no growth. The results of these tests indicate that the growing *Ascaridia lineata* normally take food from the intestinal lumen rather than from the epithelium.

15. *Observations upon the Glycogen Relationships in Ascaris.* Th. v. Brand. Johns Hopkins University.

Under anaerobic conditions the daily glycogen consumption was found to progressively decrease during the three days under observation (females, 37 C.). This may explain the differences in the reports of different authors on the daily glycogen consumption during starvation. During the first 24 hours the glycogen consumption is very similar in both sexes, but thereafter is markedly greater in the males which are more active than the females. Females, first exposed to a period of anaerobiosis and then brought into aerobic conditions, rebuild a small fraction of the consumed glycogen without receiving food. The amount of resynthesized glycogen is, in per cent of the consumed glycogen, smaller than in similarly treated free living organisms. This is due to the fact, that during

anaerobiosis *Ascaris* excretes most of the end products of the glycogen metabolism, whereas these substances usually remain within the body of free living animals.

16. *Retention of Guanidine Bases, a Toxic Factor in Trichinosis.* PAUL D. HARWOOD, JESSIE T. CUTLER, LLOYD A. SPINDLER, AND S. X. CROSS, U. S. Bureau of Animal Industry.

Toxic guanidine bases have been found a serious factor in carbon tetrachloride poisoning, toxic burns, infant diarrhoeas and occasionally in other conditions involving extensive tissue destruction, or rapid dehydration. As the symptoms of guanidine poisoning are strikingly similar to most of the symptoms of severe trichinosis, and as tissue injury is extensive in trichinosis, we have analysed the blood of experimentally infected rabbits for guanidine. Blood withdrawn from 5 rabbits shortly before death and analysed colorimetrically contained from 1.0 mgm. to 4.0 mgm. of guanidine per 100 ccm. of blood. The guanidine content of normal rabbit blood ranged from 0.38 mgm. to 0.50 mgm. per 100 ccm. The presence of guanidine in increased quantities in trichinous rabbits indicates that the clinical picture of trichinosis is probably due in some measure to this toxin in the blood, and not solely to direct injury by the worms as some recent authors have inferred. Calcium and glucose therapy has proven valuable in other guanidinemias and should, therefore, be beneficial in trichinosis. Positive results with this treatment have already been reported by some workers.

17. *A Relationship in Equines Between Age of Host and Number of Strongylid Parasites.* A. O. FOSTER, Gorgas Memorial Laboratory, Panama.

Quantitative studies of the worm burdens of 86 equines, varying in age from 9 to 30 years, have demonstrated that the animals from 9 to 15 years old were more than twice as heavily infested, on the average, with Strongylid parasites than were those over 15 years. From fifty-nine animals, 15 years and under, there was recovered an average of 1219 worms per animal as compared to an average of 502 worms for 27 animals over 15 years. Also this relationship has been demonstrated for the commoner individual species, except for *Strongylus vulgaris*, which appeared to be about as common in the older animals as in the younger. This latter interpretation has been considered of some significance because of the importance of the parasite. In addition, there was no evidence in the data of an "age-resistance" of equines against stomach worms (*Habronema* spp.). The data have been interpreted as indicating an age-resistance of equines against Strongylid parasites.

18. *Studies on Trichinosis.* I. The incidence of trichinosis as indicated by post-mortem examination of 300 diaphragms. MAURICE C. HALL AND BENJAMIN J. COLLINS, U. S. Public Health Service.

In an examination of the diaphragms from 300 cadavers at Washington, D. C., and Baltimore, Md., 41 diaphragms, or 13.67 per cent, contained trichinae. The diaphragms were examined by two methods: One gram was examined microscopically as a press preparation; the remainder of the diaphragm was ground, weighed, digested in artificial gastric juice, and put through the Baermann apparatus, and the material coming down in the funnel was examined for trichinae. The findings are quantitative, in terms of trichinae per gram of diaphragm muscle, and certain conclusions are drawn from these findings. The cases found range from very light to very heavy. The diaphragms represented persons in every decade of age from the first through the ninth. The youngest person found positive was 2½ years old, and the oldest was 95 years old. The samples appear to be representative for the population of the United States, since they include cases from the army, navy, veterans of wars, the federal hospital for the insane, and the merchant marine, all of which cases come from all over the United States, and also include cases from the population of Washington, D.

C., which comes from many parts of the United States. These cases represent whites and negroes, males and females, high and low social-economic status, military and civil groups, association with land and sea, and groups of normal mentality and a hospitalized group of deranged mentality.

19. *Studies on Trichinosis.* II. Some correlations and implications in connection with the incidence of trichinae found in 300 diaphragms. MAURICE C. HALL AND BENJAMIN J. COLLINS, U. S. Public Health Service.

The present authors have previously reported the finding of trichinae in 41 of 300 diaphragms from hospitals at Washington, D. C., and Baltimore, Md., an incidence of 13.67 per cent. In the present paper the writers have attempted to make some preliminary correlations between the incidence of trichinae and the sex, race, age and occupation of the cases studied, with a special consideration of cases of mental derangement hospitalized over relatively long periods of time as contrasted with all other cases. On the basis of the limited figures available, it appears that military groups and those associated with the sea in either a military or civil capacity have a relatively high incidence of infection with trichinae, whereas colored males of low social-economic status and cases hospitalized because of mental derangement have a relatively low incidence, with other groups intermediate and nearer the average incidence in position. A consideration of the degree of infestation, as shown by the number of trichinae per gram of diaphragm muscle, together with the case histories and post-mortem pathology, indicates that altogether a large number of clinical cases of trichinosis are never diagnosed as trichinosis.

20. *Studies on Active Acquired Resistance, Natural and Artificial, in the Rat to Infection with* Strongyloides ratti. A. J. SHELDON, Johns Hopkins University.

Quantitative studies on acquired resistance in rats to infection with *Strongyloides ratti* are reported. Necessary prerequisites to studies of this kind were (1) standardization of techniques of culturing, isolation and inoculation of infective larvae, and (2) the development of an autopsy method by which a direct count of the actual worm burden harbored by the host can be made. It was found that: (1) A marked resistance was acquired by rats as the result of an existing infection with *S. ratti.* (2) Rats could be successfully immunized by serial infections, using small doses of infective larvae. This resistance was as effective in preventing reinfection 30 days as it was a few days after the last immunizing infection. (3) An almost absolute resistance was demonstrated to be acquired and retained by rats as the result of a single previous infection which had been allowed to run its normal course and disappear. This was indicated by a very low percentage of development following the administration of a test dose five, 37, and 68 days after the previous infection had disappeared. (4) Rats could be successfully immunized against infection with *S. ratti* by serial injections of heat-killed larvae in a saline suspension. Animals which had received 13 such injections at three-day intervals (10 of 1,000 and three of 2,000 larvae) were as refractory to test infections as were animals immunized by previous or existing infections.

21. *A Laboratory and Clinical Analysis of* Strongyloides stercoralis *Infection.* E. HAROLD HINMAN, Louisiana State University.

22. *A Cerebral Coenurus from* Cercopithecus nictitans. J. H. SANDGROUND, Harvard University.

A natural infection with a species of coenurus is described from the brain of an African monkey that died in Boston. Despite the massive size of the parasite, the host showed no signs of neurological disturbance. Morphologically the ramifying larva corresponds with *C. serialis* (Gervais), recognized as a parasite exclusively of connective tissue in certain rodents and in man, as contrasted with *C. multiceps* (*C. cerebralis*) which is supposed to be characteristically restricted to the

central nervous system of herbivores (one case recorded in man). Our material may represent new evidence challenging the duality of the practically morphologically indistinguishable *M. multiceps* and *M. serialis.* It suggests the desirability of repeating the cross infection experiments of Railliet (1863) upon which the distinctness of the two species has generally been accepted.

23. *The Distribution of* Schistosoma haematobium *and* Schistosoma mansoni *in Egypt.* J. Allen Scott, Rockefeller Foundation and Department of Public Health of the Egyptian Government.

It is estimated that of the 15 million people in Egypt, 12 million live under rural conditions. Nearly 7 million of these are probably infested with blood flukes, *Schistosoma haematobium* occurring in 6 million, and *S. mansoni* in 2 million, about one million of whom have both species together. *S. mansoni* is confined mostly to the northern and eastern parts of the Nile delta and there infests nearly half of the population, or about 2 million people. In the upper or southern one-sixth of the delta only about 2 per cent of the people are infested. In Upper Egypt, that is the valley of the Nile extending for 560 miles above the delta, *S. mansoni* is rare, due to the absence of the transmitting snail. *S. haematobium,* however, is common wherever perennial irrigation has been established, namely throughout the delta and most of the lower half of Upper Egypt. It infests in these regions about 60 per cent of the 10 million rural people. It also occurs in about 5 per cent of those living in the rest of Egypt, where under basin irrigation the land is flooded once yearly, and little or no residual water exists during the rest of the year. The data on which these generalizations are based will be shown, and local variations in distribution demonstrated.

24. *The Life History and Comparative Pathology of* Fascioloides magna. T. W. M. Cameron and W. E. Swales, Institute of Parasitology, McGill University.

25. *Some New Cercariae from* Planorbis pfeifferi, Melanoides tuberculata *and* Pseudoglessula boivini. Annie Porter and H. B. Fantham, McGill University.

Many larval flukes have been obtained by the authors from the Gastropod molluscs, *Planorbis pfeifferi, Melanoides tuberculata* and *Pseudoglessula boivini.* The larval trematodes were all examined in the living state, with and without *intra vitam* staining. Photographs of detailed original drawings made from life of seven of these cercariae, all being new to science, were exhibited and described. Among the larval flukes obtained from *Planorbis pfeifferi* were an Echinostome cercaria with a new type of collar; a distome cercaria of the Agilis type which showed well-differentiated rudiments of the female genital system; a Gymnocephalous cercaria with a distinctive excretory system; a Cystophorous cercaria belonging to the Appendiculata group. From *Melanoides tuberculata,* in addition to other types of cercariae, two members of the Parapleurolophocerca group, each with a different type of excretory system, have been obtained. *Pseudoglessula boivini* yielded an interesting member of the Squamosum group of Cercariaea, the excretory system of each side of which comprised four quadruplets of flame cells connected with the anterior collecting tubule and four quadruplets of flame cells connected with the posterior collecting tubule.

26. *The Pathology of Two Trematode Infections of* Lymnaea natalensis. H. B. Fantham and Annie Porter, McGill University.

Examination of sections of the hepatopancreas of a *Lymnaea natalensis* showed extensive damage due to masses of the parthenita and cercariae of an apharyngeal, brevifurcous, oculate distome, that filled the spaces between the gland tubules. This was shown in an original photomicrograph of one of the sections. Similar examination of the hepatopancreas of another *Lymnaea natalensis,* invaded by a Plagiorchid Xiphidiocercaria, also showed pathological changes, as could be clearly seen in two original photomicrographs of sections, which were exhibited. Both types of

larval flukes caused tubule degeneration, destruction of columnar epithelium so that it resembled squamous epithelium or else disappeared, infiltration of the host tissue with excretory products of the flukes and decrease of the glycogen and protein content of the hepatic cells of the snail hosts, with concomitant increase of these substances in the tissues of the invading larval Trematodes.

27. *Notes on the Development of* Gorgodera amplicava *in the Final Host.* THERON O. ODLAUG, New York University.

A developmental phase in the life cycle of *Gorgodera amplicava* has been found in the kidneys of the final host, *Rana catesbiana.* A series of worms, ranging from the smallest indivduals in the kidneys to the sexually mature forms in the bladder, exhibits a gradually increasing development. In the youngest worms from the kidneys, the genital anlagen, with the exception of the testes, appear as a sac-like mass of cells posterior to the acetabulum. In the next stage, also from the kidney, the mass has branched into right and left lobes, and has also elongated posteriorly. The lobes become separated from the common cell mass to form two discrete bodies, the future ovary developing from the left lobe and the vitelline follicles from the right one. The uterus itself develops from the posterior elongation of the cell mass. The testes are at first represented by a variable number of components; the present work reports twelve testicular masses in the youngest stages found. This number is later reduced to ten and finally to nine, the last number being characteristic of the adult *Gorgodera.*

28. *Studies on North American Polystomes.* ALLARD ANTHONY PAUL, New York University.

Following a life history study, abstracted in the JOURNAL OF PARASITOLOGY, vol. 21, December, 1935, of *Polystoma integerrimum nearcticum* n. subsp. from the tree toad, *Hyla versicolor,* a study is being made of the life cycles of North American polystomes from the oral cavity and urinary ducts of turtles. Mature, egg-producing polystomes were removed from the oral cavity of dissected specimens of *Chrysemys picta* and transferred by pipette to the same location in other turtles which had previously not yielded eggs of the polystomes when isolated. Eggs were henceforth collected daily and placed in pond water. At the time of laying the ova were unsegmented; eleven days later the larval adhesive disc with its 16 larval hooks and the rudiments of the 4 definitive hooks were clearly distinguishable. At 14 days the worm was still surrounded by the diminishing yolk cells but fully formed. About the 26th day the worms had engulfed nearly all the yolk cells and had become active within the eggs. Hatching occurred in many cases on the 28th day. Attempts to secure infestations with the larvae are in progress.

29. *Morphology and Life History Studies of* Microcotyle spinicirrus, *a Monogenetic Trematode from the Gills of* Aplinodonotus grunniens. LESLIE W. REMLEY, University of Iowa.

Specimens of monogenetic trematodes of the genus *Microcotyle,* taken from the gills of *Aplinodonotus grunniens* were collected from Lake Okoboji. Approximately one hundred and thirty sheepshead were examined. Seventy-four per cent of those examined were infected. Adult trematodes were examined alive as whole mounts and in sections. The species was determined to be that of *Microcotyle spinicirrus* Maccallum. Life history studies show that the egg hatches in seven to eleven days. The larva has the characteristic three bands of cilia, an anterior eye spot, a pharynx opening into a sac-like gut and an ovoid haptor posteriorly. The haptor has fourteen hooks, two large posterior ones and six pairs of smaller ones located on its ventral surface. The larva is free swimming, negatively phototropic and attaches to the gills of the same fish or another of the same species where it develops to sexual maturity. Bullheads, crappie, blue gills and perch when exposed, failed to acquire the parasite. Attachment forms were studied in all stages of development. The ventral sucker of the haptor of the adult develops near the junction of the hap-

tor with the body. As these develop, the larval haptor is pushed back and is lost by constriction. Hooks of the larva and the sucker framework of the adult gave negative chitin tests.

30. *A Sporozoan Parasite of Larval Trematodes.* W. E. MARTIN, Purdue University.

Cercariae emerging from *Succinea sp.* collected in the region of Woods Hole, Mass., were found to harbor a sporozoan parasite. Cysts of varying size were observed in both the body and tail of the cercariae, either imbedded in the tissues or forming conspicuous protrusions of the body and tail surfaces. In crushed snails, the sporozoan was observed in both snail and trematode tissues and infection of the parthenitae and their enclosed germ balls was noted. The sporozoan is apparently a normal parasite of the mollusk that has become adapted to live in larval trematodes. It is not limited to a single trematode species, since cysts have been observed in three species of cercariae emerging from this mollusk. One of the cercariae, an echinostome, encysted in the snails and retained the sporozoan in the metacercarial stage. Occasionally cercariae are found with their tissues riddled by this parasite which suggests that it may interfere with the completion of the life cycles of these trematodes.

31. *The Occurrence of* Euryhelmis squamula *(Rudolphi, 1819) in the United States.* ALLEN MCINTOSH, U. S. Bureau of Animal Industry.

Specimens of *Rana pipiens* collected near Alexandria, Va., were found infested with metacercariae of a small trematode. The infested frogs were fed to cats, and mature flukes, identified as *Euryhelmis squamula* (Rud., 1819), were obtained postmortem five days later. This fluke appears not to have been reported previously from the United States, although specimens of the parasite, collected from mink from Maryland and Minnesota, are in the Helminthological Collection of the U. S. National Museum.

32. *The Specific Validity of the Human and Pig Ascaris, Based on a Comparative Study of Spermatogenesis and Oogenesis.* LAWRENCE S. RITCHIE, Northwestern University and the Woman's College of the University of North Carolina.

Although the relationship of the human and pig *Ascaris* has been given considerable attention, the problem has not been completely solved. Anatomical and histological studies suggest that the two forms are identical. The morphological findings are supported by serological and toxicological investigations. On the other hand, cross-infection experiments suggest that the human *Ascaris* does not commonly reach maturity in the pig and vice versa. Further, it has been shown that the larvae of the pig *Ascaris* develop more rapidly than those of the human *Ascaris.* Hiraishi successfully infected pigs, which had been placed on a vitamin-deficient diet, with human *Ascaris* eggs. This finding may tend to clarify the problem; or it may confuse it even more, for there remains the possibility that there is a difference in the degree of resistance on the part of the pig against the two ascarids. The present study extends the morphological comparison of the human and pig *Ascaris* by means of detailed comparison of spermatogenesis and oogenesis. Oogenesis, from early diakinesis through the formation of the resting pronuclei, has been studied in detail. A complete investigation of spermatogenesis, including gonial divisions, synapsis, growth, diakinesis and the maturation divisions has been made. The observations indicate that the stages of gametogenesis are strikingly similar in the two forms.

33. *Experimental Infestations of Rats and Mice with* Capillaria hepatica. GEORGE W. LUTTERMOSER, Johns Hopkins University.

Capillaria hepatica eggs isolated from the livers of the brown rat, *Rattus norvegicus,* have been shown to be infective for the domesticated albino mouse and hooded rats. This nematode develops and matures in much the same fashion

in the mouse and rat. Doses as low as *500 eggs* were lethal to immature mice while *1,000 eggs* killed *80%* of *31* adult mice during the fourth week of infection. About *20%* of *76* immature hooded rats died of *5,000 eggs* each. Not one of the adult hooded rats died of *10,000 eggs*. *Capillaria hepatica* is more often lethal to the mouse than the rat apparently because of the smaller size of the liver and because the worms and eggs are not confined to that organ within the mouse. Furthermore, mice did not acquire sufficient protection from the attempted single or multiple immunizing doses of from *40* to *250 eggs* against subsequent lethal test doses. The albino mice exposed to primary, secondary, and tertiary infestations died in the same proportions.

34. *The Life Cycle of* Ophidascaris labiatopapillosa *Walton, 1927.* A. C. WALTON, Knox College.

Larvae from cysts in the stomach, mesenteries and body wall of *Amphiuma tridactylum, Rana aesopus, R. catesbiana* and *R. sphenocephala* developed into adult specimens of *Ophidascaris labiatopapillosa* Walton, 1927 in species of *Natrix*. The adult form had been earlier reported from *Coluber constrictor*. Mature eggs fed to *Rana pipiens* gave rise to encapsulated larvae indistinguishable from those fed to the snakes at the beginning of the feeding experiments. The life cycle seems definitely to consist of alternation between the adult condition in snakes and the larval form in amphibia. The possibility of an insect acting as an intermediate host between the snake and the amphibian is not ruled out, since the incidence of infection by forced feeding was far less successful than the abundance of natural infections would lead one to expect. The opportunities for direct passage of eggs from the snake host to amphibian host are probably not as abundant in nature as would be the passage by way of an insect vector.

35. *A Suggested Life Cycle for* Multicaecum tenuicolle *(Rud., 1819) Walton, 1927.* A. C. WALTON, Knox College.

Larval forms of a species of *Multicaecum* obtained from stomach cysts in *Rana catesbiana, R. sphenocephala* and *Siren lacertina* were found to develop into adult examples of *Multicaecum tenuicolle* (Rud., 1819) Walton, 1927, in *Alligator mississippiensis*. This is the normal host of this species. Mature eggs were not available to feed to amphibia to definitely complete the life history, but the evidence available seems quite suggestive since the experimental animal was parasite-free before the feeding experiments were undertaken.

36. *Effect of Irradiated Ergosterol on Trichinized White Rats.* WAYNE W. WANTLAND, Northwestern University.

Eighteen white rats infected with *Trichinella spiralis* were studied with regard to the effect of different amounts of irradiated ergosterol *per os* (1) upon rate and degree of calcification of cysts and (2) upon the host. Rats infected with approximately 2500 larvae and treated with 60 and 100 drops of irradiated ergosterol per day, beginning the thirty-first day after infection, showed no calcium deposits in cysts after 10 to 16 days' treatment. Irradiated ergosterol in the amounts indicated exerts a marked toxic effect upon trichinized white rats and unless discontinued causes death. Rats infected with approximately 1200 larvae and treated with from 40 to 50 drops of irradiated ergosterol per day, beginning the fifty-fourth day after infection, showed from slight to medium calcification fed to other rats irradiated ergosterol *per os* does not accelerate calcification of of cysts 127 days after infection and marked polar calcification of cysts 157 days after infection. Oral adminstration of from 40 to 50 drops of irradiated ergosterol per day eventually proved fatal to two treated rats in this series. Treatment was discontined in the remaining treated rat 160 days after infection and the animal lived until killed 225 days after infection. Autopsy of this animal revealed resorption of calcium from cysts and 33 per cent of the larvae digested out of various striped muscles exhibited no motility and were shown to be nonviable when fed to other rats. Irradiated ergosterol *per os* does not accelerate calcification of

cysts in trichinized rats to the extent that it does in trichinized rabbits. At the present time the toxicity factor in activated ergosterol is not thoroughly understood nor is there agreement as to its mode of action.

37. *Effect of Irradiated Ergosterol and Irradiated Milk on Calcification of Trichina Cysts in Cats.* Wayne W. Wantland, Clayton Hansen, and Robert E. Feeney, Northwestern University.

Each of seven cats was infected with approximately 300 *Trichinella spiralis.* Three of these animals were given irradiated ergosterol (10,000 U. S. P. units Vit. D per gm.) plus ordinary milk. Two others were fed irradiated milk (approximately 120 U. S. P. units Vit. D per liter). The remaining two animals were controls and were fed ordinary milk. A daily ration of canned meat was included in the diet of all seven animals. The three cats receiving irradiated ergosterol (40, 50 and 70 drops respectively per day beginning the third day after infection) showed very slight calcification of cysts as early as the thirtieth day following infection. These daily doses of ergosterol proved toxic to all three treated animals. At autopsy medium to marked calcification of cysts was observed in two of the treated cats in various striated muscles (53 and 55 days following infection). Long filamentous processes of calcium deposits at the poles of cysts were noted. The two cats given irradiated milk (350 c.c. daily) grew remarkably and remained in an excellent state of health until both were placed on irradiated ergosterol (50 drops per day). After three days these animals exhibited marked loss of appetite and the hair began to lose its lustre. The ergosterol was discontinued and both animals soon regained their appetites and smoothness of coat. In neither of the cats given irradiated milk did early calcification of cysts occur. Capsule form was slightly thicker at the poles than in control animals.

38. *Parasite Reactions to Host Modifications.* Robert Hegner, Johns Hopkins University.

President's address.

39. *Variations in* Dientamoeba fragilis *and a Suggestion as to its Pathogenicity.* D. H. Wenrich, University of Pennsylvania.

Dientamoeba fragilis obtained from more than 70 hosts was found to be very much more variable for some cases than for others. Sizes range up to 20 microns in diameter; ratios of binucleate to mononucleate individuals vary greatly from case to case and from stool to stool for the same case. While the characteristic nucleus appears to be a vesicular one with four granules clumped in the middle and without evident chromatin on the nuclear membrane, variations include increases in number of granules, great enlargement of one of them which is regarded as the true endosome, and sometimes the presence of a small amount of stainable material on the nuclear membrane. It is difficult to determine what variations may be considered normal or abnormal. The history of certain cases leads to the suggestion that this species may, at times, be somewhat pathogenic for some hosts.

40. *Exposure of Three Endoglobular Bovine Parasites to Different Degrees of Temperature.* Chas. W. Rees, U. S. Bureau of Animal Industry.

Red blood cells infected with *Anaplasma* were frozen for 18 hours in dry ice at −78.6 C., thawed at 25° C., and injected into a heifer; anaplasmosis developed in this animal. Twenty injections of red blood cells heated at temperature from 44.5° to 60° C., were made into susceptible cattle; the cells were infected with *Anaplasma marginale* and in some cases with either *Babesia argentina, B. bigemina* or both. In one case *A. marginale* survived heating from 25° C. to 60° C., the heating being stopped immediately when the latter temperature was reached; as a result of the heating the virulence of the organism was greatly reduced. *A. marginale* was killed by a temperature of 60° C., applied for 15 minutes, 20 minutes, and 60 minutes, respectively. In 2 tests this organism was killed by heating 10 minutes at 57° C., in 4 tests at 54° C., in 2 tests at 48° C.; it survived in 2 tests following an exposure for

10 minutes at 50° C., at 48° C., and at 45° C., respectively. In tests involving exposure for 10 minutes at 50° C., and at 48° C., blood containing *A. marginale* was mixed with that of *B. bigemina*; in 1 test at 48° C., the blood also contained *B. argentina*. In all 5 tests the anaplasms survived while the piroplasms perished. At 45° C., the 3 parasites survived, while in a second test at this temperature *A. marginale* and *B. argentina* survived while *B. bigemina* perished, the virulence of *B. argentina* being reduced. *B. bigemina* survived at 44.5° C., without loss of virulence. In 11 cases the injection of red blood cells in which *A. marginale* had been killed by heat failed to immunize susceptible cattle to subsequent injections of virulent blood.

41. *A Twenty-Four Hour Asexual Cycle in a New Strain of* Plasmodium praecox (relictum). Fruma Wolfson, Johns Hopkins University.

A strain of *P. praecox* (*relictum*) was isolated by the author from a male Wood thrush (*Hylocichla mustalina*) caught in Baltimore. The maximum number of merozoites produced by mature schizonts of this strain exceeded that of other strains reported from this country, being often 20 and sometimes as high as 24. In determining the length of the asexual cycle, more than 10 canaries were studied by methods recently employed by the author with other avian plasmodia. A high degree of synchronicity was observed in all canaries infected with this strain. The percentage of a given stage varied regularly between approximately 100% and 0% at given times during the cycle. Sporulation period was sharply defined and limited to about 4 hours during each cycle. Periodicity was marked and the length of the cycle was 24 hours. The maximal number of forms with 6 or more nuclei occurred at about 6 A. M. each day, while at 10 A. M. there was nearly 100% of young merozoites present in the circulating blood. Only mononucleate stages could be seen for about 12 hours of every cycle, between about 10 A. M. and 10 P. M.

42. *The Cultivation of* Trichomonas foetus *Free from Bacteria.* Justin Andrews, Johns Hopkins University.

For nearly two years the author has been attempting to isolate and maintain *T. foetus* free from bacteria *in vitro*. From this experience, certain improvements in technical procedures have evolved and are herewith presented. Six strains have been successfully freed from bacteria and have been cultured for periods varying from several weeks to over nine months. Both the animal inoculation method of Riedmuller and the migration method of Glaser and Coria have been repeatedly employed with success in separating the trichomonads from bacteria. The latter method has been completely confirmed in principle but certain modifications of the technique as published have been found desirable. The viability of *T. foetus* in saline mixtures containing blood on egg substrates is discussed in relation to the quantitative and qualitative composition of the medium. Standard tests for bacterial sterility are suggested.

43. Trichomonas columbae *as a Cause of Death in the Hawk.* Robert M. Stabler and Herman A. Shelanski, University of Pensylvania.

On the seventeenth of March, 1936, one of the senior author's small falcons (*Falco s. sparverius*) died of an accidental infection with *T. columbae*. During the last few days of her life she refused all food, the evident discomfort attendant upon the passage of food through the crop preventing her from swallowing. At autopsy, the mouth and crop were found to be swarming with the flagellates and they were recovered from nowhere else in the body. The infection was traced to pigeons upon which the hawk had been fed and an examination of twenty birds from the same source revealed a flagellate incidence of 100 per cent. A Red-shouldered Hawk (*Buteo l. lineatus*) was next fed on the heads and crops of pigeons known to be positive for *T. columbae* and on April 24, 1936, it died as had the Sparrow Hawk, refusing food. An examination showed it to be infected with the flagellates from mouth to stomach. Sections of the tissues of these hawks have failed to reveal any

penetration by the parasites. We have demonstrated culturally that when the head, neck and crop of an infected bird are exposed to refrigerator temperatures, one week is insufficient to kill all the protozoa. Among the organisms obtained from the pigeon crops we have found numerous multinucleate specimens, some containing as many as nine nuclear and flagellar complexes. Further study on *T. columbae* is in progress.

44. *Hyperparasitism: A Species of* Hexamita *(Protozoa, Flagellata) Found in the Reproductive Systems of* Deropristis inflata *(Trematoda) from Marine Eels.* A. V. HUNNINEN AND RALPH WICHTERMAN, Oklahoma City University and Temple University.

A protozoon (*Hexamita* sp.) was discovered to be a hyperparasite in the reproductive organs of *Deropristis inflata.* It was found in large numbers in the uterus, oviduct, seminal receptacle, and inside of the eggs and less commonly in the vitelline glands and testes. In cases where the infection was heavy the protozoa were found in large numbers in every trematode. The *Hexamita* was not found in other species of flukes in the same eels or in the intestinal contents of the eel itself, thus suggesting organ and host specificity for this flagellate.

45. *Division and Conjugation in* Nyctotherus cordiformis *(Ehr.) Stein (Protozoa, Ciliata) with Special Reference to the Nuclear Phenomena.* RALPH WICHTERMAN, Temple University.

A cytological study of the complete life cycle of *Nyctotherus cordiformis* (Ehr.) Stein, a heterotrichous ciliate from the large intestine of tadpole and adult *Hyla versicolor* hosts is presented. A tadpole becomes infected by ingesting cysts. In the intestine, the protozoon excysts and divides. In division a partial dedifferentiation of parental ingestatory structures occurs, then redifferentiation to be retained by the anterior daughter. For the posterior daughter, the ingestatory apparatus arises *de novo.* In conjugation, two ciliates fuse along their peristomes. The macronucleus undergoes complete fragmentation while the micronucleus divides three times. The first pregamic division results in two micronuclear products; the second division, four micronuclear products, three of which degenerate. The remaining product enters into the third pregamic division to produce the two functional, migratory and stationary, pronuclei. Interchange of migratory pronuclei follows at the fused anterior ends of the conjugants to form the amphinucleus which divides once to produce the micronucleus and the macronuclear anlage. Development and behavior of the unusual macronuclear anlage ("spireme ball" of Stein and Schneider) is described for the first time. At the end of the conjugation process, ingestatory structures of each conjugant completely dedifferentiate while a complete new set arises *de novo* posterior to the old ones. Conjugation occurs only in tadpoles which are metamorphosing into frogs. The process of conjugation is interpreted here as an effort made by the ciliates to overcome a physiological crisis during the drastic host transformation changes.

46. *Experimental Amoebiasis in Rats with Cysts of Human Carriers.* H. TSUCHIYA, Washington University School of Medicine.

Washed cysts of 3 human carriers known to be pathogenic to kittens were fed to albino rats by means of stomach tube. It was found that the infectivity to rats apparently varied with the feeding time of the animals. Of 13 positives out of 78 rats employed, a higher infection rate was observed in the animals on empty stomachs (6 out of 25) than when the stomachs were full (3 out of 31). By an addition of 1% $NaHCO_3$ to the feeding 4 out of 22 rats became infected. This suggests that the similar condition may exist in man and partly explain why the incidence of amoebiasis is relatively low despite many possible avenues of transmission. No apparent gross and microscopic lesions were observed in all the infected rats. Spontaneous disappearance of cysts occurred in 3 animals, while one rat remained as a carrier till the time of autopsy.

47. *Ciliates Infesting Acapulco Sea Urchins.* PHILIP B. A. POWERS, University of Pennsylvania.

An infestation similar to that found among the sea urchins of the Gulf Stream was obesrved among two species of sea urchins taken from the Pacific Ocean at Acapulco, Guerrero, Mexico. In the specimens of Echini taken from 3–4 fathoms, *Cryptochilium bermudense* was the dominant form, while those taken from the shore line harbored *Metopus circumlabens* as well as a smaller form; *Cryptochilidium bermudense* as well as another species similar to one described from Japanese Echini; *Anophrys elongata, Cohnilembus caeci* and *Cyclidium* sp. This record from Acapulco forms a link between the infestations among the Echini of the Orient and those of the Gulf Stream. The ciliates described by Lynch from the California coast were lacking.

48. *A Race of* Trichomonas augusta *in the Liver Abscesses in a Frog.* ROBERT M. STABLER AND MIRIAM I. PENNYPACKER, University of Pennsylvania.

While examining frogs (*Rana pipiens*) for their trematode parasites one of us (M. I. P.) discovered in the liver of one specimen, three fairly large and prominent abscesses. On microscopic examination the lesions were seen to be filled with a sero-purulent exudate plus myriads of *Trichomonas augusta.* The flagellates appeared typical, being similar to those found in the gut of the same host, and sections showed them to be extensively invading the tissue surrounding the abscesses. Attempts at cultivation were unsuccessful. The question as to how these organisms, normally inhabiting the digestive tract of the host, came to be situated in the liver and in association with pathological lesions, remains unanswered.

49. *The Sucking Lice of American Monkeys.* HENRY E. EWING, U. S. Bureau of Entomology and Plant Quarantine.

The known sucking lice of American monkeys constitute four closely related species of the genus *Pediculus.* One of these, which was formerly confused with *Pediculus humanus americanus,* is described as new. All are placed in the previously established subgenus *Parapediculus,* which includes only American monkey-infesting forms. Studies of the egg and nymphal stages of these four species reveal relationships to the man-infesting forms of *Pediculus* on the one hand and the chimpanzee-infesting species on the other. The new evidence brought forth further supports the writer's hypothesis that the sucking lice of American monkeys were derived originally from those of American Indians. But little evidence is produced supporting the hypothesis that the genus *Pediculus* is a generalized one whose species are to an unusual degree free from the infleunce of host environment.

50. *The Louse Fly,* Lynchia fusca, *Parasite of the Owl,* Bubo virginianus pacificus, *a New Vector of Malaria of the California Valley Quail.* W. B. HERMS AND C. G. KADNER, University of California.

In 1928 O'Roke found an infection of the erythrocytes of the California Valley quail by a parasite which he named *Haemoproteus lophortyx* and in his studies concluded that transmission is effected by the louse fly, *Lynchia hirsuta.* The present investigation was undertaken to determine if other species of louse flies could transmit the infection. For this purpose the louse fly, *Lynchia fusca,* of the owl, *Bubo virginianus pacificus,* was used. This species feeds readily on quail. After the flies had been fed on infected quail, they were transferred to birds which had been proved negative for *Haemoproteus* on repeated examination. The incubation period of the infection in the fly was from 9 to 23 days and the incubation period in the quail was 25 to 26 days when gametocytes were found in the blood becoming abundant in a few days. It is concluded that *Lynchia fusca,* a parasite of an owl, may act as a vector of quail malaria.

51. *The American Dog Tick or Eastern Rocky Mountain Spotted Fever Tick.* F. C. BISHOPP AND CARROLL N. SMITH, U. S. Bureau of Entomology and Plant Quarantine.

Dermacentor variabilis, the American dog tick, is found throughout the United States except in seven of the western states. It is most abundant along the Atlantic, Pacific, and Gulf coasts and in the Mississippi Valley. It is the vector in the East of Rocky Mountain spotted fever, a highly fatal disease reported from 23 eastern states and the District of Columbia. A member of the "three-host" group of ticks, the larvae and nymphs engorge on small rodents and occasionally birds, while the adults attack the larger mammals. Records as to the number and relative importance of the hosts, engorging and molting periods, longevity, oviposition, and natural control factors are given.

52. *Equine Encephalomyelitis in Western Montana in 1936. A Brief Discussion of the Implications of Arthropod Transmission.* CORNELIUS B. PHILIP AND HERALD R. COX, U. S. Public Health Service.

An outbreak of this disease in the Bitterroot Valley in late July, August, and early September provided opportunity for a first-hand study of arthropod species that were in contact with the local horse population during the period. Laboratory animals were subjected to mass inoculations of collected materials in an attempt to recover the virus with negative results. A confirmed strain, isolated from a local case, was sufficiently invasive, although of low virulence, in guinea pigs to be demonstrable in the circulation almost throughout the entire period of infection. A brief discussion of attempted mosquito and tick transmission in the laboratory is also presented together with a reel showing field conditions and typical symptoms observed in the outbreak.

53. *Penetration of the Common Sunfish by the Holostome Cercaria,* C. multicellulata. GEORGE W. HUNTER, 3d, Wesleyan University.

Cercaria multicellulata Miller 1923, emerging from *Physa gyrina,* penetrates the common sunfish, *Eupomotis gibbosus* (Linn.), producing the metacercaria, *Neascus vancleavei* (Agersborg). The parasites first appear in the liver within 8 to 11 days, at which time they are 200 to 360 μ long by 48 to 136 μ wide. At the end of 14 to 17 days the parasite has developed many of the characteristics of the metacercaria, *N. vancleavei,* including fore and hind body, reserve bladder, excretory system, anlagen of both holdfast organ and acetabulum, as well as the fundaments of the reproductive organs. Exposure for 24 to 36 hours gave such a heavy infection that the liver and kidney were riddled by parasites. Thirty-one *E. gibbosus* used as controls were negative for this parasite.

54. *On the Life History of* Apophallus venustus *with Observations on the Life History of* Parametorchis *in Canada.* T. W. M. CAMERON, Institute of Parasitology, McGill University.

The eggs of the Heterophyid trematode *Apophallus venustus* hatch after being swallowed by the snail *Goniobasis livescens* and give rise to cercariae with eye-spots and long flanged tails. These cercariae encyst in a great variety of fresh-water fish (including Bull-head and Small-mouth Black Bass) and the adult trematodes are found in fish-eating mammals and birds. The life cycle of *Parametorchis* is probably very similar; experimental infections in cats have resulted from feeding on suckers and what is probably the cercaria of this trematode has been found in a species of *Amnicola.*

55. *The Life Cycle of* Cercariaeum lintoni *Miller and Northrup.* HORACE W. STUNKARD, New York University.

Under this same title, Glading (1935) presented a paper before the annual meeting of the Society at St. Louis. He confirmed in part the observations of Shaw (1933) and Stunkard (1933) but reported that the cercariae encyst in annelids as "mesocercariae." According to Glading, when infected annelids are eaten by crabs of the genus *Hemigrapsus,* the mesocercariae excyst, penetrate the intestinal wall and re-encyst on the outer surface of the pericardium and in the muscles as

metacercariae. Such metacercariae develop to maturity in the intestine of the gull, *Larus californicus*. He reported that the adult worm belongs to the genus *Levinseniella*. Therefore, he changed the name of the species to *L. lintoni*. My earlier studies have been continued and confirmed. *Cercariaeum lintoni* of Miller and Northrup is identical with *Distomum lasium* Leidy, 1891. These larvae encyst in the parapodia of *Nereis virens* and other annelids. After three weeks in the second intermediate host, the metacercariae were fed to various fishes and developed to sexual maturity in the intestine of the eel, *Anguilla chrysypa*, and the toadfish, *Opsanus tau*. The worms persisted for two to three weeks in the intestine of *Paralichthys dentatus* and *Tautoga onitis*, and it is probable that they reach maturity in these species. Natural infections were found in the eel. The adult worms are specifically identical with *Zoogonus rubellus* (Olsson, 1868), (synonym, *Zoogonus mirus* Looss, 1901).

56. *The Life History of* Diphyllobothrium mansonoides. JUSTUS F. MUELLER, N. Y. State College of Forestry.

The coracidium is fully developed within the egg at the end of nine days, but the time of hatching varies from 9 to 120 days. The first intermediate host is a species of *Cyclops, C. leuckarti,* or *C. viridis* serving equally well, in which the procercoid appears fully developed after a lapse of 14 days, but is not infective until after 21 days. The second intermediate host is a mouse, either house or field variety, in which, after 14 days, the plerocercoid has attained a length of 3 to 4 mm., at which time it is already infective if fed to the cat. At the end of 60 days the plerocercoids in mice are from 5 to 10 cm. long, and are found mainly under the skin of the back and neck region. The mouse seems to be the normal host, since in it the plerocercoid reaches its greatest size. Rats, rabbits, guinea-pigs, and monkeys are usually resistant to oral infection, but can be infected by surgical transfer of the plerocercoid, or by subcutaneous injection of copepods containing infective procercoids. The rabbit appears to be an unfavorable host for the plerocercoid even when it is introduced surgically at full size. Frogs or birds cannot be infected. In these animals, when the plerocercoid is introduced surgically, it is killed and absorbed. There is no reproduction of the plerocercoid within the tissues of the rodent host. Extensive search has so far failed to locate the plerocercoids in nature. Adults reared in cats under varying conditions show uniformly the morphology distinctive of the species. Experiments now in progress will determine to what extent wild carnivores may serve as host to the adult, and will elucidate other important questions of life history and immunity.

57. *The House Fly and Fowl Tapeworm Transmission.* J. E. ACKERT AND W. M. REID, Kansas State College.

The recent discoveries of numerous species of ground beetles, as intermediate hosts of chicken tapeworms, raised the question of the importance of the house fly, *Musca domestica,* in the spread of chicken tapeworms. Two methods of inquiry were adopted: (1) the placing of helminth-free chickens in non-fly-proof cages near a flock of chickens infested with tapeworms, and (2) the individual examination of house flies trapped near this flock. Twenty chickens two months old were put into cages, so placed as to admit only flying insects. The chickens were given a normal ration plus sour buttermilk as a fly attractant. Numerous house flies from the poultry yard were attracted to the cages and eaten by the chickens. After 46 days, the chickens were killed and examined. Fifteen of the 20 chickens were infested with the cestode *Choanotaenia infundibulum* and one bird also harbored two specimens of *Raillietina cesticillus*. The range of infestation was from one to 28 tapeworms with an average of 9.8 worms per fowl. In the second part of the inquiry 478 house flies were dissected. In four of these *Musca domestica,* fully developed cysticercoids of *Choanotaenia infundibulum* were found. The range of infestation was from one to 91 cysticercoids, with an average of 28.5. It is evident from these studies that *Musca domestica* is a potent factor in the spread of the fowl tapeworm, *Choanotaenia infundibulum.*

58. *Progress of Spirochaete Infection in the Developmental Stages of the Host Tick,* Ornithodoros hermsi *Wheeler.* CHARLES M. WHEELER, Pacific Institute, University of California.

A series of experiments was conducted to test the ability of clean larval ticks of the species, *Ornithodoros hermsi,* to acquire spirochaetes of California relapsing fever from white mice previously infected through the bites of infective ticks. The progress of the spirochaete infection through the subsequent developmental stages of the host tick was noted and the results compared with the progress of infection in progeny reared from naturally infected female ticks. Tests have shown that clean larval ticks, when permitted to feed on infected animals, produced a greater number of transmissions than did larval ticks which acquired their infection hereditarily from naturally infected females.

59. *Parasites of* Amphiuma tridactylum. HARRY J. BENNETT AND JOSEPH D. RE, Louisiana State University.

Examination of 28 adult hosts collected from June, 1935, to June, 1936, was made. The following parasites were found. *Cephalogonimus amphiumae* Chandler 1923 in 21 hosts with infestation ranging from 2 to 308 specimens; *Diplodiscus americanus* (Chandler 1923) in 3 hosts with infestation ranging from 1 to 11 specimens; *Cercorchis amphiumae* (Chandler 1923) in 6 hosts with infestation ranging from 1 to 3 specimens; *Vitellotrema fusipora* Guberlet 1928 in 5 hosts with infestation ranging from 1 to 8 specimens. Two specimens of *Ophiotaenia* which were immature were collected from one host.

60. *Experimental Studies on the Trematode,* Parorchis acanthus *Nicoll.* RAYMOND M. CABLE, Purdue University.

Adults of *Parorchis acanthus* are obtained by feeding metacercariae to either gulls or terns, but not by feeding to ducklings or any mammals that have been tried. Negative results are also obtained when ducklings are placed on a fish diet and all attempts at transferring young trematodes from infected terns to the cloaca of ducklings or the large intestine of laboratory mammals have been unsuccessful. When metacercariae are fed at intervals to young birds, trematodes at corresponding stages of development are recovered, indicating that the earlier infections do not inhibit the establishment of infections from subsequent feedings. Trematodes were removed surgically from six birds at varying lengths of time after each had been fed a known number of cysts. After recovery from the operation, each bird was fed metacercariae a second time. Five of the birds died before the end of the experiments. The remaining one, from which four trematodes had been removed 22 days after an initial feeding of 40 metacercariae, was fed an additional 40 cysts five days after the operation. Sixteen trematodes were recovered 14 days later when the bird was killed, indicating that the earlier infection had not rendered the host immune to subsequent exposure to the parasite. In two birds which failed to become infected at the first feeding, a subsequent exposure produced infection. Hence, it does not seem that either age or previous infection render the natural hosts of *P. acanthus* immune to this species, although definite conclusions require additional data.

61. *Experimental Studies on* Neascus vancleavei. M. S. FERGUSON, University of Illinois.

Experimental studies show that the strigeid metacercarian, *Neascus vancleavei* (Agersborg) develops to maturity in the intestine of chicks. *Neascus* from *Hyborhynchus notatus* and from *Helioperca incisor,* upon rearing in avian hosts, give evidence of belonging to the same species of *Neodiplostomum.* The species of *Neodiplostomum* obtained by experimentally feeding *N. vancleavei* to chicks is probably identical with the one represented in nine collections of strigeids recovered from the intestines of three species of herons. Chicks, one to three days old and of several breeds, may be infected with certainty if they have never been fed. Food may be supplied immediately after infection. *N. vancleavei* de-

velops to the adult condition in about 35 hours and strigeid eggs appear in the chick feces a few hours later. Even though the adult worms have developed to maturity in an unnatural host, their eggs will hatch in about three weeks. A heavy infestation of adult worms can be obtained in chicks when the metacercarian cysts are fed in lots of 50 to 100 at intervals of 30 to 45 minutes over a period of several hours. Worms tend to disappear from the intestine of chicks in about two weeks and those remaining rarely show more than one or two eggs in the uterus while many are without eggs. It has also been observed that the uteri of specimens of *Neodiplostomum* from natural hosts often contain very few or no eggs.

62. *A Note on the Geographical Distribution of the Genus* Haplosplanchnus (*Trematoda*). H. W. MANTER, University of Nebraska.

The trematode family Haplosplanchnidae contains the single genus *Haplosplanchnus* in which, to date, a single species, *H. pachysomus* (Eysenhardt), from the Mediterranean has been recognized. There can be identified at least six species of *Haplosplanchnus* from marine fishes at Dry Tortugas, Florida. These six species exhibit considerable host specificity, each being limited to certain related hosts. Two species show an interesting extension of their geographical distribution to the Pacific. *H. acutus* (Linton) from *Tylosurus raphidoma* (Ranz.) and *T. marinus* (Walbaum) at Tortugas and from *T. acus* (Lacépède) at Bermuda have been collected by the writer from *Tylosurus fodiator* Jordan & Gilbert from the coast of Colombia. A new species of *Haplosplanchnus* occurs in two species of *Pomacentrus* (*P. leucostictus* Müller & Troshel and *P. xanthurus* Poey) at Tortugas and what seems to be this same species I have collected from *Pomacentrus rectifraenum* Gill in the Galapagos Islands. This latter distribution is of special interest because the Pomacentridae are not far swimming fish but shallow water "reef fish." Studies now in progress dealing with the trematode fauna of Tortugas and the Pacific are expected to give further indication of an earlier shallow water connection between the two oceans and probably extending to the Galapagos Islands.

63. *Some Peculiarities in the Occurrence of Gyrodactyloid Trematodes on North American Fishes.* JUSTUS F. MUELLER, N. Y. State College of Forestry.

A sufficient number of the more important common fresh water fishes from the east, south, and middle west have now been examined to indicate some of the peculiarities in the distribution of native Gyrodactyloidea. Trout carry only *Gyrodactylus elegans,* on the skin and fins, not on the gills. A very similar *Gyrodactylus* occurs on the goldfish. Other species of *Gyrodactylus* occur on the buffalo fish, sucker, *Umbra,* and *Fundulus. Dactylogyrus* is represented by only two species, *D. anchoratus* (a European form) on goldfish, and a native species on carp, both gill parasites. The Tetraonchinae occur most abundantly on the gills of Centrarchids, from which family to date 24 species are shown, six, for instance, occurring on the common sunfish. Three interrelated species occur on the gills of Silurids, two on perch and pike perch. *Esox lucius* has a single species, *T. monenteron,* common to Europe and America. *E. reticulatus* shares a single species with the unrelated *Lepibema chrysops.* Certain fishes show a peculiar immunity from infestation with this group. Thus, *Amia, Lepidosteus,* and *Lota* have been examined from numerous localities, but harbor no gill parasites. The war mouth bass, *Chaenobryttus,* appears to enjoy a similar immunity. No Tetraonchinae occur on trout, suckers, or cyprinids. No *Gyrodactylus* or *Dactylogyrus* occur on Centrarchids, Silurids, the perch, or pike families. Since warm weather promotes attacks of these parasites in the north it might seem that they would be unusually abundant in the south. Collections in Florida, however, show no higher incidence than in the north, increased immunity on the part of the host apparently offsetting any accelerated reproduction on the part of the parasite.

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1925	Kansas City	1930	Cleveland
1926	Philadelphia	1931	New Orleans
1927	Nashville	1932	Atlantic City
1928	New York	1933	Boston
1929	Des Moines	1934	Pittsburgh
		1935	St. Louis

IN MEMORIAM

Franklin Davis Barker (1877–1936)

The death of Professor Franklin Davis Barker on July 10, 1936, at the age of fifty-eight came as a shock to his friends and colleagues. Dr. Barker received his A.B. degree from Ottawa University, Ottawa, Kansas, in 1898 and his Master's degree from the same institution two years later. He served as professor of biology at this institution from 1898 to 1903 when he moved to Nebraska where he was a member of the Department of Zoology until 1926, having the rank of professor from 1913 to 1926. At Nebraska in 1910 he obtained his Ph.D. degree. Here he started his studies on trematodes which he continued for many years. He also developed a graduate student group which cooperated with him in his researches. In 1926 Dr. Barker was called to Northwestern University as professor of zoology and head of the department and here he remained until the time of his death. At Northwestern he continued his work in the field of parasitology and broadened his interest. Here he was able to gather around him a group of graduate students and develop a center for training men in his chosen field.

For many years Dr. Barker was an associate editor of the Journal of Parasitology and he served for a period on the council of the American Society of Parasitologists, of which he was one of the charter members. He seldom missed a meeting of the society and enjoyed nothing more than the informal contacts which the meetings afforded. Dr. Barker's publications all gave evidence of meticulous care and sound work. He also interested himself in the development of the teaching of parasitology and his courses in this subject were models of careful organization. His untimely death is a distinct loss to American parasitology and he will be missed by his many friends and acquaintances.

Akira Fujinami (1870–1934)

The death of Dr. Akira Fujinami on November 18, 1934, removed one of the greatest and best known figures in Japanese medical science. In 1895 Dr. Fujinami graduated from the Tokyo Imperial University and spent the next four years studying in Germany where he devoted himself chiefly to the rapidly developing science of pathology. He returned to Japan in 1899 to become professor of pathology in the Imperial University of Kyoto, the position which he held until his retirement in 1930. During the term of his professorship Dr. Fujinami built up a great research department in pathology in which he trained many students who are now contributing in an important way to the development of the medical sciences in Japan.

While Dr. Fujinami always had a keen interest in the field of parasitology and directed the work of many students on researches in this field, he was best known to parasitologists for his pioneer work on Schistosomiasis japonica. He was one of the first to show that this disease was produced by a trematode parasite and in 1909 demonstrated the method of infection by skin penetration in a carefully controlled series of experiments on cattle. With the aid of his students he contributed extensively to our knowledge of the pathology and control of this disease. He was also the first to study the immunological relations of this parasite. The extent of his work on this disease is shown by the fact that from 1904 to 1918 he published about 30 papers on this subject, including an extensive monograph in 1916, and many more were published independently by students working in his laboratory. In 1918 he was awarded the prize of the Imperial Academy of Japan for his researches on schistosomiasis.

Dr. Fujinami was well known to American parasitologists and was a member of the Japanese group which traveled widely in 1922 in the United States under the auspices of the Rockefeller Foundation. Among the many marks of recognition that Dr. Fujinami received from foreign scientists was honorary membership in the American Society of Parasitologists. He was a man of fine character and delightful personality. He was loved and admired by his students and associates and highly esteemed by all who knew him.

Seitaro Goto (1867–1935)

Professor Seitaro Goto, one of the most famous zoologists that Japan has produced, died on July 18, 1935. A quotation from the Japanese Journal of Zoology tells of his early life: "In the twilight of old Japan, at the close of the Shogunate régime, on August 18, 1867, Seitaro Goto was born as the second son of Moriatu Goto, a samurai of the Tyôsyû clan, who took part in the great task of the Restoration. When he was three years old, his father, a man of marked intelligence and foresight, moved to Osaka, then the center of the movement for enlightenment in Japan at the dawn of her new era. Through early education the boy became well versed in English, as well as showing an eager interest in flowers and insects. When young Seitaro was fourteen years old he entered upon a life of devotion, being baptized at the Tenma Christian Church. Two years later Goto entered Dôsisya College where he came in contact more closely with the current ideas of the West."

Dr. Goto graduated from the College of Science of the Tokyo Imperial University in 1890 and received the D.Sc. degree from the same institution in 1895. In August, 1894, he went to the Johns Hopkins University where he came under the influence of Professor W. K. Brooks and the brilliant group of young men who were associated with him. He went

later to Harvard University and studied with Professor E. L. Mark. In 1896 he returned to Tokyo to become professor of zoology in the "First Higher School" of the Tokyo Imperial University and in 1909 he was appointed to the chair of zoology in the College of Science. He continued as professor of zoology in the Tokyo Imperial University until his retirement in 1928 and also served as dean of the College of Science. He served on the editorial staff of the Annotationes Zoologicae Japoneses, the Journal of the College of Science, Tokyo Imperial University and the Japanese Journal of Zoology. He also served from 1920 up to the time of his death as a member of the National Research Council of Japan. He received many honors both at home and abroad and represented his university and country at a number of scientific meetings.

To parasitologists Professor Goto is best known for his work on the monogenetic trematodes. His extensive monograph published in 1894 laid the foundations for the modern studies on this group and was one of the most important of the early studies by Japanese parasitologists. In 1913 Dr. Goto was awarded the prize of the Imperial Academy for his brilliant pioneer work on Japanese trematodes. He continued his interest in the trematode group up to the time of his death and worked on the digenetic as well as on the monogenetic forms. Not only through his own researches but also through those of his students did he make for himself an important place in Japanese parasitology. His researches were not limited to parasitic worms since he was an authority also on the morphology and embryology of the coelenterates and the echinoderms.

Professor Goto had a broad culture and attractive personality. He was greatly esteemed by his students and associates and was a distinguished man in any company either at home or abroad.

Robert Knowles (1883–1936)

In the death of Lt. Col. Robert Knowles, I.M.S., the field of parasitology has lost one of its most active workers. His life was devoted to research on some of the most important diseases of India and to the training of students to carry on this work.

Dr. Knowles was born in Travancore, India, and was educated at Downing College, Cambridge, and at St. Mary's Hospital, London. He qualified for medicine in 1907 and entered the Indian Medical Service in 1908. From 1908 to 1912 he was Past Civil Surgeon in Jhansi and from 1912 to 1914 served as the Assistant Director of the Pasteur Institute of India at Kasauli. From 1914 to 1915 he served as a medical officer with the Indian Expeditionary force in Mesopotamia and was from 1916 to 1920 Director of the Pasteur Institute at Shillong in Assam. In 1920 he was made the Organizing Secretary of the Calcutta School of Tropical Medicine and had an important part in the organization of this institution. He served as Professor of Protozoology in this institution from

1921 to 1936 and was its director at the time of his death. Always an enthusiastic and hard working investigator he made important contributions to our knowledge of malaria, kala-azar, surra, and amebic dysentery. He also served as assistant editor of the Indian Medical Gazette from 1922 to 1928 and was the editor of this journal from 1928 to 1933. He was the author of well known books on medical protozoology, malaria and dysentery.

He is perhaps best known for his extensive researches on kala-azar and especially for the discovery of the development of Leishmania donovani in sand flies. His most recent protozoological research was on malaria in monkeys. He was known as a fine teacher and administrator and the success of the Calcutta School of Tropical Medicine has in a large measure been due to him. His untimely death at the height of his career was a great loss to the field of protozoology.

George Alexander MacCallum (1843–1936)

Dr. G. A. MacCallum died in Baltimore on September 30, 1936, at the age of 93. He was born in Toronto, Canada, and graduated in medicine from Victoria College in 1866. From 1868 to 1901 he engaged in the practice of medicine in Dunnville, Ontario. From that time until 1907 he was Superintendent of the Asylum for the Insane in London, Ontario, and from 1907 to 1910 was the Superintendent of the Hospital for the Insane at Penetanguishene, Ontario.

At the age of 67 he retired from his medical work and moved to New York to live with his son, Dr. W. G. MacCallum, who was at that time Professor of Pathology at Columbia University. Dr. MacCallum had always had a keen interest in natural history and during this long medical career he made extensive collections of birds and bird eggs which he prepared himself. He had also made a large collection of Indian relics in Ontario. After his arrival in New York he became interested in the parasitic worms, especially those of fishes. He worked in the laboratory of pathology at Columbia University on the parasites of fishes from the New York Aquarium and on those of animals from the Bronx Zoological Park. The summers he spent at Woods Hole, Massachusetts, in the laboratory of the U. S. Fish Commission, where he worked especially on the parasites of marine fishes. He was made a Fellow of the New York Zoological Society in 1916 and at that time became pathologist to the New York Aquarium. Later in 1921 he was made pathologist for the Bronx Zoological Park. In 1921 he moved to Baltimore, Maryland, but continued his work during the summers at Woods Hole. His studies continued until four years before his death when he was forced to give them up on account of ill health. During the years of his work in New York and at Woods Hole he had made a very large collection of parasitic worms which he gave to the U. S. National Museum in Washington several years before his death.

Dr. MacCallum is best known to parasitologists for his extensive publications on both ectoparasitic and endoparasitic trematodes, most of which were published in Zoopathologica. His first publications in this field appeared after he had reached the age of seventy and continued for almost twenty years.

Sir Arnold Theiler (1867–1936)

The sudden death of Sir Arnold Theiler last summer on the eve of the Congress of Microbiology of which he was Vice-President removed one of the outstanding leaders in the field of veterinary science. To the field of parasitology he contributed in an important way by his researches on the parasitic protozoa of domesticated animals and by organizing the Onderstepoort Laboratories at Pretoria, South Africa, in which has developed one of the great world centers for research on the parasites of domesticated animals.

Sir Arnold Theiler had a most interesting and colorful career. He was a native of Switzerland. At the age of 24 after completing his education in veterinary medicine at Berne he left his native land to settle in the Transvaal. Here his abilities were soon recognized and in 1896 President Kruger appointed him veterinary surgeon for the republic, in which capacity he served until 1900. From 1900 to 1910 he served as government bacteriologist and from 1910 to 1918 he was the Director of Veterinary Research for the Union of South Africa. He created during his government service the Onderstepoort Institute and served as its director for over a quarter of a century. The organization of the veterinary faculty of the Union of South Africa in 1920 was due almost entirely to his efforts. He served as Professor of Tropical Veterinary Medicine on this faculty from 1920 to 1927 and was its dean from 1923 to 1927. After his retirement in 1927 he served as advisor first for the Australian and later for the British Government.

In the field of parasitology his most important researches were on anaplasmosis and piroplasmosis in cattle and equines. His early work on these diseases was fundamental and laid the foundations for later advances. In addition to his own researches he stimulated important research activity in his associates and directed the practical application of the results of researches. He was one of those rare individuals who combined a flair for research with unusual administrative capacity and the ability to convince government officials that research pays. Few men have received greater recognition for their accomplishments during their lives. He was presented with many medals and was an honorary member of a number of foreign scientific societies, including the American Society of Parasitologists.

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